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THE LONGEVITY OF *CORYNEBACTERIUM SEPEDONICUM* ON POTATO BAGS WHEN PLACED UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

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Tests were begun in 1942 at the Wyoming Agricultural Experiment Station to study the problem of the persistence of the ring-rot bacterium, *Corynebacterium sepedonicum*, on potato bags under various environmental conditions. More recently, this study has included tests to determine if these bacteria can be killed by exposing the contaminated bags to sunlight for different lengths of exposure.

EXPERIMENTAL METHODS

In most cases, tubers infected with both ring rot and soft rot have been used as sources of inoculum, such as would occur commonly in nature. This inoculum has been placed either in the burlap bags and vigorously shaken around in them or rubbed on the sacks to insure heavy contamination. In the latter cases, the areas contaminated have been outlined with a black marking pencil so that they could be located accurately later on. The bags were rolled and tied in small bundles and placed either inside or outside of the storage cellar. When ready to test, the contaminated burlap was cut from the bag and placed in a small quantity of water to release the bacteria. Freshly-cut seed pieces were then placed in this solution for periods of one minute or more. The seed pieces were then planted in field plots. Readings were made several times during the growing season for the presence of ring rot.

During the spring of 1946, 100-pound burlap bags were contaminated by rubbing small areas of the bags (6" x 6") with tubers heavily infected with ring rot. These bags were then hung up singly on the south side of a building so that they would be exposed to direct sunlight during the day. The bags were exposed for 10, 20, 30 and 40-day periods before testing them for the presence of viable bacteria. A similar test was made with bags stored in the greenhouse away from direct sunlight for the same periods of time. At the termination of the testing period, the contaminated portions of the sacks were laid on a sterile surface and rubbed with freshly-cut seed pieces of healthy Bliss Triumph potatoes. These were planted in field plots in 10-hill rows, replicated four times.

Experimental Results

Tests conducted during 1942, 1943 and 1946, indicated that ring rot bacteria may be carried on potato bags stored either inside or outside of potato storage cellars during the period from November to June. Results of this nature are shown in table 1.

Table 1.—*The survival of ring-rot bacteria on potato bags inside and outside of cellars (November to June)*

	Positive Evidence as Carriers of Ring Rot*		
Kind of Bags and Location	1942	1943	1946
Burlap bags in cellar	+	+	+
Burlap bags outside of cellar		+	+
Canvas bags in cellar			+
Canvas bags outside of cellar			+

*Most of these tests gave some negative evidence in certain replications.

The sacks listed in table 1 were rolled up in bundles and not spread out as they were in table 2. In the latter case, the bags were hung singly with full exposure to the sun. The extent of the carry-over of ring-rot bacteria is shown in table 2.

Table 2—*The effect of sunlight on the survival of ring-rot bacteria on burlap bags.*

	Duration of Test and Resulting Ring Rot (4 Replications)			
Location of Burlap Bags	10 Days	20 Days	30 Days	40 Days
	Per cent	Per cent	Per cent	Per cent
South side building (outside)	70	49	20	10
Inside building (attic)	95	95	66	70

The results show a decided reduction in ring rot with increased length of exposures to weather conditions. However, a 40-day period was not sufficient to eliminate the ring-rot bacteria completely from the burlap bags. The test shows that the bacteria survived relatively well on bags inside, away from the sunlight.

SUMMARY

It is generally thought that ring-rot bacteria may be carried on burlap bags for long periods of time, the length of which varies with the environmental conditions.

In tests conducted during 1942, 1943 and 1946, it was found that ring rot bacteria may be carried in a viable condition on burlap bags tied in bundles for periods of seven months when stored both inside and outside the cellar. However, some of the tests were negative for this period. Where 100-pound burlap bags, previously contaminated, were hung singly by the ends and the whole surface of one side exposed to the sun, the ring-rot bacteria were greatly reduced but not completely eliminated after periods of 40 days. Similar bags placed inside, away from the sun, were found to carry viable bacteria, with little reduction, for the same period of time.

ACCURACY OF THE ULTRAVIOLET LIGHT METHOD IN SELECTING POTATO TUBERS FREE OF VIRUS

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Ultraviolet light has been discussed or used by a number of investigators (1, 2, 3, 5, 6, 8, and 9) as a means of detecting the ring rot organism in potato tubers. Iverson and Harrington (10) found when examining the cut ends of tubers that there were several types of fluorescence which differed in color, location, and intensity. They concluded that the use of ultraviolet light was a very satisfactory method for detecting ring rot, but noted that some types of fluorescence indicated the presence of viruses. They recommended the elimination from seed stocks of all tubers showing any type of fluorescence. Later, Iverson and Harrington (7) found in using tubers of the Netted Gem variety that the ultraviolet light method was just as effective as the gram stain method for detecting ring rot in tubers. They also were of the

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opinion that the ultraviolet light method had additional value in reducing the incidence of other "vascular" diseases. McLean and Kreutzer (11) working with the variety Bliss Triumph believed that they could identify with reasonable accuracy virus diseases and virus-disease complexes on a basis of color, location, and intensity of fluorescence.

In order to test the usefulness of ultraviolet light in detecting the presence of virus diseases in tubers grown in northern Maine, all tubers showing fluorescence in several lots of potatoes being examined for ring rot were saved. There were nine varieties: Katahdin, Sebago, Chippewa, Green Mountain, Spaulding Rose, Irish Cobbler, Sequoia, Mohawk, and Bliss Triumph. A number of tubers showing fluorescence of one type or another from each variety were planted on Aroostook Farm, Presque Isle, Maine. They were observed for any appearance of virus diseases which might be carried by the tubers. There seemed to be no correlation between fluorescing of the tuber and the appearance of a virus disease in the plants growing from these tubers.

Sufficient data were obtained to raise the question of the accuracy of determining specific virus diseases by the ultraviolet light method. A large percentage of the fluorescing tubers produced apparently healthy plants. To test further the accuracy of ultraviolet light in detecting virus diseases, it was decided to use one virus, leaf roll, in several varieties for study.

Materials and Methods

In several plots on Aroostook Farm, hills of potatoes showing definite severe leaf roll symptoms were marked, and harvested at the end of the growing season. The varieties used were Katahdin, Spaulding Rose, Sebago, Green Mountain, Irish Cobbler, Chippewa, and sixteen seedling varieties, as yet not named. Each hill was carefully dug and the tubers stored in a separate cloth bag. They were held at a temperature of about 35° F. from the 10th of October, 1945, to the 5th of February, 1946, when they were examined. Each tuber was cut across the stem end and examined immediately under an ultraviolet light lamp. Other sources of illumination were excluded. A record was made immediately after each examination. A summary of the data obtained is shown in table 1.

Discussion and Conclusions

The types of fluorescence observed were quite distinct. The heavy vascular fluorescence was markedly more intense than the light vascular fluorescence. The blue cortical area was quite distinct with an

TABLE 1.—*Type of fluorescence shown by tubers from vines having distinct leaf roll symptoms.*

Variety or Seedling	Number of Tubers Tested	Type of Fluorescence						
		None	General Yellow	Light Vascular	Heavy Vascular	Blue Net	Blue Cortex, Yellow Pith	Blue Pith, Yellow Cortex
Katahdin	86	5	0	71	0	0	5	5
Spaulding Rose	76	13	0	45	0	18	0	0
Sebago	67	4	0	27	0	1	30	5
Green Mountain	38	4	0	30	0	4	0	0
Irish Cobbler	37	4	0	27	0	3	3	0
Chippewa	45	3	25	7	0	0	7	3
Seedling No. 1	16	1	0	15	0	0	0	0
2	14	1	12	1	0	0	0	0
3	15	0	0	4	0	2	9	0
4	32	6	0	17	0	1	8	0
5	31	3	0	25	3	0	0	0
6	41	2	0	27	0	12	0	0
7	57	3	0	44	4	6	0	0
8	26	1	0	24	1	0	0	0
9	31	14	0	17	0	0	0	0
10	35	22	0	9	0	0	4	0
11	23	7	0	13	0	3	0	0
12	8	1	0	6	0	0	1	0
13	6	3	0	3	0	0	0	0
14	20	1	8	1	0	0	0	10
15	29	1	0	9	0	13	6	0
16	44	4	1	17	0	4	18	0
	777	103	46	439	8	67	91	23
Per Cent	100.0	13.2	5.6	56.5	1.0	8.8	11.7	2.9

equally distinct yellow pith area. An identically reverse condition was apparent in some tubers where the cortex was yellow and the pith section blue. In other tubers a blue-netted fluorescence appeared which was usually, but not always, associated with symptoms of net necrosis. In some varieties, notably Chippewa or seedlings with Chippewa parentage, a considerable number of the tubers showed a general bright yellow fluorescence over the freshly cut surface.

From the table it is apparent that there is no consistent correlation between fluorescence and the presence of leaf roll virus in the tuber. Some varieties, such as Katahdin, show a light vascular fluorescence in a relatively high percentage of the tubers examined. Other varieties, notably Chippewa, show a low percentage of light vascular fluorescence in tubers from vines showing distinct leaf roll symptoms. It is interesting that more than 50 per cent of all the tubers examined show a type of light vascular fluorescence. These data would support the conclusion that fluorescing tubers, particularly those with a light vascular fluorescence should be eliminated. That of other types is of less importance. Although the removal of all fluorescing tubers would greatly decrease the percentage of virus-infected tubers in a seed lot, not all of the diseased tubers would be eliminated.

Summary

In an effort to determine the accuracy of ultraviolet light in detecting virus diseases of potatoes, it was found:

(1) That potato tubers fluorescing under the ultraviolet light, when planted, produced a considerable percentage of healthy plants;

(2) That tubers of twenty-two varieties taken from plants showing distinct leaf roll symptoms exhibited several types of fluorescence; and

(3) That more than 50 per cent of the tubers from leaf roll plants showed a light vascular fluorescence.

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RESULTS OF SPRAYING AND DUSTING POTATOES IN MICHIGAN IN 1946

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In the spraying and dusting experiments on potatoes at the Lake City Experiment Station in 1946, twenty-four spray and fifteen dust materials were compared with bordeaux mixture and monohydrated copper sulfate-lime dust. DDT was added to ten of the spray materials at the rate of three-fourths pound of 100 per cent DDT to each 100 gallons of spray and three pounds of pure DDT to each 100 pounds of mixed dust. To the others DDT at various strengths or other organic insecticides were added. One series of plots was sprayed and one dusted with DDT at the same rate as that above but with no fungicide added as controls.

The sprays were applied at the rate of 150 gallons per acre and 400 pounds pressure at intervals of ten days during the period from the 27th of June to the 29th of August inclusive. Applications were made with a power take-off four row sprayer. Dusts were applied at the same intervals and dates at the rate of 50 pounds per acre, with an engine driven self-mixing rotary dusting machine. A canvas trailer curtain 30 feet long was attached behind the dust nozzles and allowed to drag behind the machine to prevent the dust being blown away.

The plots consisted of four rows of potatoes 250 feet long and 36 inches wide. The soil of the spray plots was very sandy and varied considerably in fertility, whereas that of the dust plots was clay loam and much more homogeneous. Therefore, yields are not comparable. The variety Menominee was used in all plots and planted on the 16th of May.

[1]Research Professor of Botany and Plant Pathology.
[2]Associate Professor of Entomology.
[3]The writers are indebted to Mr. A. M. Berridge, Superintendent Lake City Experiment Station for providing facilities for carrying on this project and continued interest in the investigation.
[4]Published by permission of the Director Michigan Agricultural Experiment Station. Journal Article number 856 (N.S.).

Harvesting was done on the 7th and 8th of October, 1946. Four harvestings of 40 feet of row were made at the same intervals from the two center rows of each plot except in one plot where these rows fell on the dead furrow. In such cases the two outside rows were used. The plots were irrigated five times during the season by means of a rotary sprinkler system. Two-acre inches of water were applied at each irrigation. Potato insects were abundant during the season but were readily controlled by the use of DDT or other insecticides in each application of fungicide. Late blight was not seen in any of the plots and early blight, present in only slight amounts in most plots was not a factor in yield. Blossoming of the potatoes continued until the killing frost on the 31st of August.

Results of the Lake City Experiments

Results of the spraying experiment are given in table 1. In these plots the highest yield of U. S. No. 1 potatoes was obtained from the

Table 1.—*Results of spraying potatoes in* 1946. *Lake City Experiment Station.*

Material*	Yield in U.S. No. 1[1]	Bushels per Acre Total
1. Bordeaux — 8-12-100	234.6	241.7
2. Bordeaux — 8-4-100	197.2	212.3
3. Tribasic — DDT 4-½-100	196.6	212.1
4. Tribasic — DDT 4-¼-100	207.3	219.7
5. Tribasic — DDT 4-¾-100	209.3	226.4
6. Tribasic — sulfur DDT 4-4-¼-100	226.4	235.5
7. Copper oxychloride sulfate 5-100	191.4	208.0
8. F 48 Bordow 4-100	201.1	218.2
9. Copper A compound 5-100	201.0	210.2
10. Yellow cuprocide 11/2-100	240.7	254.5
11. Tribasic—DDT 4-1-100	261.9	271.0
12. Tribasic—DDT 4-4-100**	229.7	241.8
13. Zinc nitrodithioacetate—DDT 2-1-100	219.3	287.5
14. Bordeaux BHC 8-4-2-100	191.3	203.2
15. Tribasic—BHC 4-2-100	168.9	180.6
16. Zinc nitrodithioacetate—BHC 2-2-100	183.6	199.0
17. Copper nitrodithioacetate—BHC 2-2-100	183.7	196.0
18. Phygon 1-100	215.9	226.0
19. Zerlate 2-100	238.8	247.9
20. Tribasic-Dethyl 4-1 pt.-100	232.0	241.8
21. Tribasic-Omilite 2-1 qt.-100	219.6	231.7
22. Tribasic-Hercules 3946 4-¾-100	218.1	226.9
23. DDT alone ¾-100	261.3	275.5
24. Dithane-zinc sulfate-lime 2qt.-1-½-100	313.5	325.4
25. Dethyl 1 pt.-100 alternating with F48 Bordow-Dethyl 4-1 pt.-100	321.4	322.5

*Unless otherwise stated in table, ¾ pound DDT was added to each 100 gallons of spray.

**Tribasic copper sulfate and DDT ground together with no inert carrier.

[1]Least difference for significance at 5 per cent level = 57.4 bu. per acre.

plot sprayed with Dethyl alternating with F48 Bordow plus Dethyl (DDT in oil) followed by Dithane-zinc sulfate-lime-DDT. These yields are significantly better than those of any of the other plots except those sprayed with DDT alone and a tri-basic copper sulfate plus one pound of DDT ground together (plot 11). There was no significant difference in yield between any of the other materials except in plots 15, 16 and 17 although the yields of the plots sprayed with Yellow Cuprocide, Zerlate bordeaux mixture 8-12-100 plus DDT and Tribasic-Dethyl were higher than that of most of the other materials. The addition of benzene hexachloride (BHC) to bordeaux mixture or the zinc and copper salts of nitro-dithioacetate appeared to depress yields. Since insect infestation, early blight and late blight were not factors in curtailing plant growth, the increased yields from the plots sprayed with Dithane, Dethyl-F48 Bordow, tri-basic copper sulfate plus one pound of DDT and DDT alone may possibly be attributed to lack of plant injury caused by these materials or this factor plus the added effect of the DDT in the sprays.

Results of the dusting experiment are given in table 2. Due to soil variations, yields of spray and dust plots are not comparable. From these data it is seen that with the exception of plot 7 (Tribasic-DDT 2 per cent) there were no conspicuous differences in yield between any of the plots although the 5 per cent impregnated yellow cuprocide-DDT gave highest yield. It is interesting to note that the presence of a high concentration of lime, (plot 1) seemingly had no deleterious effect upon yield and

TABLE 2.—*Results of dusting potatoes in* 1946. *Lake City Experiment Station.*

Material*	Yield in U.S. No. 1[1]	Bushels per Acre Total
1. Mono. copper-lime—DDT 3 per cent	349.0	356.1
2. Copper A-PCH	346.0	357.9
3. Tribasic—DDT 3 per cent	346.6	361.1
4. Copper oxychloride sulfate—DDT 3 per cent	358.7	369.7
5. F-48 Bordow—DDT 3 per cent	340.1	351.5
6. Copper A Comp'd—DDT 3 per cent	353.5	364.6
7. Tribasic—DDT 2 per cent	297.6	307.1
8. Tribasic—DDT 1 per cent	328.8	343.6
9. Tribasic—DDT ½ per cent	303.2	316.1
10. Tribasic-Sulfur—40 per cent—DDT 3 per cent	335.6	353.1
11. Yellow cuprocide—DDT 3 per cent (impregnated)	361.3	376.1
12. Yellow cuprocide—DDT 5 per cent (impregnated)	366.6	380.4
13. Tribasic—BHC 10 per cent	352.1	364.5
14. Basicop—DDT 3 per cent	350.1	357.6
15. DDT 3 per cent alone alternating with F-48 Bordow—DDT 3 per cent	344.4	355.6
16. DDT 3 per cent alone	355.7	369.0

*All copper materials used at 7 per cent metallic strength. All dusts except numbers 1, 4. and 16 ready mixed.

[1]Least difference for significance at 5 per cent level = 56.6 bu. per acre.

TABLE 3.—*Results of spraying potatoes in the Upper Peninsula, 1946.* Yield in bushels per acre U. S. No. 1.*

County	Bordeaux 8-4-100	Zerlate 2-100	Copper A 5-100	F48 Bordow 4-100	Dithane** 2qt.-100	Tribasic 4-100	COCS 5-100
Alger	232.0	230.2	210.6				
Dickinson	336.5	294.3	333.7				
Marquette	347.7	355.5	256.7				
Delta	325.0			280.0	299.0		
Houghton	338.3	344.1		320.8	350.8		355.8
Iron	229.4			243.7	153.8		
Baraga	332.7					293.5	319.3
Menominee	283.6					315.0	340.1
Schoolcraft	366.3					335.0	301.5

*DDT added to each spray at the rate of ¾ pound in 100 gallon.
**Zinc sulfate 1 lb. + ½ lb. lime added.

from close observation did not lessen the effectiveness of DDT in the control of potato insects. In the virtual absence of early and late blights the use of copper fungicides in this experiment showed neither stimulation nor depression of yields. As in the sprayed plots blossoming of plants continued until the killing frost on the 31st of August.

Results of the Upper Peninsula Experiments

Further tests of the effectiveness of various spray materials were made in growers' fields in nine counties of the Upper Peninsula. In these tests approximately one acre of potatoes was sprayed with each of two fungicides in comparison with bordeaux mixture 8-4-100. DDT was added to all sprays at the rate of three-fourths pound in each 100 gallons. Results of these tests are given in table 3, and show a considerable variation in yield of plots in the three counties where the same materials were used. In the three county trials taken together there were no significant differences in yields among materials. Early blight was not a factor in any of the fields. Late blight was present as slight infection in the plots in Menominee, Schoolcraft, Marquette and Houghton counties. In these plots infection appeared to be evenly distributed during the first week of September, but further development of the disease was prevented by killing frosts during the middle of the month.

Summary

In the experiments at the Lake City Experiment Station, potatoes sprayed with Dithane-zinc sulfate-lime DDT and F48-Bordow-Dethyl gave yields significanly better than those of any other materials employed. It seems possible that lack of injury to the plants from these materials or this factor and the added effect of DDT may be responsible for the increased yields. Bordeaux mixture 8-12-100, Zerlate and Yellow Cuprocide Tribasic-DDT ground together and DDT alone resulted in yields higher than those of the other materials employed, although these differences in yield were not statistically significant in every case.

The results of the dusting experiments, using fixed coppers in comparison with monohydrated copper sulfate-lime showed no significant differences in yield between these materials plus DDT or DDT alone.

Considerable variation in yield was found between plots sprayed with the same materials in different counties in the Upper Peninsula. Using the plots of identical materials in each of three counties as added replicates of materials, there was no significant difference in yield between the various sprays.

Late blight was absent in the Lake City Experiment Station tests and early blight was present in only slight amounts. In the Upper Peninsula plots late blight was present in Menominee, Schoolcraft, Marquette and Houghton counties but its development was stopped by early killing frosts before any appreciable damage resulted.

THE OVERWINTERING OF *PHYTOPHTHORA INFESTANS* (MONT.) de BARY UNDER LONG ISLAND CONDITIONS

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The disease of potatoes which is now recognized as late blight made its first appearance in the United States in 1843 near the city of Philadelphia, (Stevens 1933). In 1845 its destructive occurrence in Ireland resulted in the catastrophe we now refer to as the "Irish Famine." The rapidity with which this disease was capable of destroying a food crop as economically important as potatoes stimulated considerable speculation and study on the part of the early horticulturists and mycologists both in this country and in Europe. De Bary (1861) established beyond doubt the causal relationship of *Phytophthora infestans* (Mont.) de Bary to the disease and, among other things, determined most of the essential facts in the life cycle of the pathogen as they are now known. In spite of contributions made to the knowledge of potato blight within the past century, doubt exists as to the origin of inoculum for primary infections. The question still remains, how does the blight pathogen overwinter and become established each year? It is the expressed opinion of many that the diseased shoot from a diseased tuber as described by de Bary occurs too infrequently under field conditions to be effective in establishing the disease from year to year. The occurrence of diseased aerial shoots from infected seed pieces has, in fact, been so rare that it has been regarded as worthy of special mention in publication.

The area of the South Fork of Long Island is an intensive potato raising section in which the current season spread of the leafroll virus makes it necessary to import new seed each season. This area is ideally suited for studies on the overwintering of *P. infestans*, for late blight, with but few exceptions, makes an annual appearance. This area is bounded on three sides by water and on the fourth and west side by a stretch of land unsuited for most agricultural purposes. Fog and rain usually occur with southerly or easterly winds off the Atlantic Ocean. Although these winds are accompanied by conditions favorable for the development and spread of *P. infestans* they, at the same time, exclude all possibility of wind borne inoculum capable of initiating the disease. The north or northwesterly winds are drying land breezes, unfavorable for the development of blight.

Infected Shoots Produced from Diseased Seed Pieces:

De Bary (1861) suggested that diseased aerial shoots may arise from infected seed pieces. He failed to prove his theory, however, until

1876. Among others who have noted that diseased shoots may arise from infected seed pieces may be mentioned Jensen (1887), Melhus (1915), Pethybridge (1911), Salmon and Ware (1926), Alcock and McIntosh (1927), and Murphy and McKay (1927). Unsuccessful in their attempts to produce diseased shoots from infected tubers were Kühn (1870), Hecke (1898), Clinton (1906), Jones *et al* (1912), Löhnis (1922) and others.

In the experiments conducted on Long Island, seed of the variety Green Mountain was inoculated with *P. infestans* in such a manner that when the tubers were cut longitudinally, each half contained a lesion of approximately the same size and location. A total of 90 seed pieces in groups of 30 were planted in soil which had never before supported a crop of potatoes. The plants were enclosed in cages covered with waterproof paper. To test the possibility of the fungus infesting the soil surrounding infected seed pieces and shoots, the lower leaves in one set of plants were pinned to the soil; in another group they were immediately excised; and in the last set, the soil was covered with waterproof paper. Diseased individuals were removed as soon as noticed.

Fifty of the inoculated seed pieces failed to grow; thirty-one gave rise to apparently healthy plants, while nine seed pieces or ten per cent of the total number produced diseased aerial shoots. These shoots were not all produced at the same time but appeared over a period of several weeks. Some shoots were small and died soon after emerging above ground, although others superficially appeared normal. In the former case the pathogen soon invaded the entire shoot, while in the latter only part of the circumference of the stem was invaded. The discoloration on the stem could be traced back to the center of infection on the tubers in all cases. After a period of twenty-four hours infected shoots that had been placed in moist chambers were covered with mold and the organism was positively identified as *P. infestans*. In no other way did infection of the plants take place than by the growth of the fungus up through the shoot from the diseased seed piece. Most of the seed pieces which failed to produce plants had sprouted but the sprouts were killed before they reached the surface of the soil. The size and location of the lesion on the seed piece may be the critical point in the production of diseased shoots. Too large a lesion or a lesion located too close to an eye may result either in rot of the tuber or destruction of the eye before a shoot has become established.

Under field conditions results of this nature would be expected with only a very small percentage of infected seed pieces actually producing diseased aerial shoots. Infected aerial shoots produced from diseased seed pieces were actually observed under field conditions on Long

Island. Such infected plants were rare and existed for only a short time early in the growing season. "Spot infections" in a field in which the disease spreads in a centrifugal manner from a few primary foci is not an uncommon observation. It has been noted by Melhus (1915), Brooks (1919), Beaumont (1934), and Crosier and Reddick (1935) and others who have worked in areas where blight annually makes its appearance.

Under normal conditions the incidence of tuber rot caused by *P. infestans* is very small on Long Island. It is possible, however, that diseased tubers left in the field at digging time might survive the winter in favorable locations and produce infected volunteer plants the following spring. A search was made for volunteer plants in grain fields on which potatoes had been produced the year before. Infected potato plants were readily found but none of these appeared to have been produced from diseased tubers.

The cull pile as a source of inoculum has been incriminated by Bonde and Schultz (1943). Plants growing on the cull pile have been observed to be infected on Long Island early in the month of June. The disease was observed spreading from the cull pile to adjacent fields.

A number of hypotheses have been advanced to supplement the infected shoot as the source of primary inoculum. Among these may be listed mycelium from infected seed pieces or shoots infesting the surrounding soil; sporangia or swarm spores infesting the soil surrounding infected seed pieces; mycelium existing saprophytically in the soil; overwintering spores, and other suscepts, as for example, perennial solanaceous weeds.

Sporangia or Swarmspores Infesting the Soil Surrounding Infected Seed Pieces:

Data which may be interpreted as indicating that sporangia or swarmspores produced in the soil are ineffectual as inocula for primary infections on Long Island were presented by Skaptason *et al* (1940). It was reported that sporangial germination in soil obtained from potato fields on Long Island was greatly reduced when compared to germination on soils on which a crop of potatoes never has been grown. In the area of the South Fork of Long Island, Bordeaux mixture has been universally used for many years in the control of late blight. The copper content of these soils was shown to be high in both total and replaceable copper and it was suggested that copper might be responsible for the reduction in sporangial germination.

Further germination tests were conducted in soil obtained from the greenhouses in Ithaca, New York, and from a number of widely separated potato fields on Long Island. All tests were conducted in

moist chambers. Small but equal amounts of soil were placed directly on glass slides. Measured amounts of distilled water were added in such a manner that a film was formed around the periphery of the soil samples. Sporangia were introduced into the film of water immediately or after a period of 72 hours had elapsed. The slides were subjected to optimum temperatures for the germination of sporangia. A spore dilution of approximately 150 sporangia per low power microscopic field was used and the germinated individuals in a total of 400 sporangia were counted per treatment. This experiment was duplicated.

The results of this experiment (table 1) show that the period of leaching had very little effect on the rate of sporangial germination which occurred only in soils obtained from the greenhouses in Ithaca. Slight sporangial germination occurred in the soil samples taken from

TABLE 1.—*Percentage sporangial germination in suspensions made from soils obtained from the greenhouses at Ithaca, N. Y., and from potato fields on Long Island.*

Soil Samples	Period of Leaching in Hours	
	0	72
Plant Science Greenhouse, Ithaca	82.4	52.5
Potato Greenhouse, Ithaca	57.8	10.4
Sagaponack 1	s	s
Sagaponack 2	s	s
Sagaponack 3	—	—
Sagaponack 4	—	—
Sagaponack 5	—	—
Sagaponack 6	—	—
Southampton	—	—
Bridgehampton	—	—
Watermill	—	—
Commack	—	—
Riverhead	—	—
Distilled Water	77.3	78.5

s—Slight sporangial germination.

fields Sagaponack 1 and Sagaponack 2. Both of these fields have been cropped to potatoes for only a few years. Data of this nature substantiate that reported by Skaptason *et al.* From a practical standpoint, the formation in the soil of sporangia or swarmspores which might function as inoculum for primary infections is of no importance in the annual outbreak of late blight on the South Fork of Long Island.

Saprophytic Existence of the Pathogen in the Soil:

The saprophytic existence of *P. infestans* in the soil was first suggested by Kühn (1870). This hypothesis was supported by Brefeld (1883) chiefly on the basis of his success in culturing the organism on

an artificial medium. Darnell-Smith (1912) reported that potatoes planted in soil which he had infested with diseased tubers produced only healthy plants. Similar results were reported by Stewart (1913) and Clinton (1936). Observations of this nature have been the experience of most workers. Tucker (1931) reported the sporangia or oospores of *P. infestans* were not able to survive an exposure to low winter temperatures at Columbia, Missouri. Miss deBruyn (1922), however, reported that she was able to grow the fungus on sterilized soils such as clay, bog, leaf mould and sand. In 1926 she reported good growth of the fungus on sterilized plants from a number of unrelated families. Good growth was obtained on grass and on various cereal straws. On the basis of her experiments Miss deBruyn suggests that the fungus might live saprophytically in soils containing organic material derived from these plants.

A number of unrelated plants and several types of soil were tested as potential media for the growth of *P. infestans* and the results are presented in table 2. Growth of the organism was good on dried potato stems, barley, oat and wheat heads but very poor on the straws of these grains.

TABLE 2.—*Growth of P. infestans on various substrata.*

Substratum	Fungous Growth and Sporulation
Carrots	1
Equisetum stems	1
Polypodium stems	1
Dried potato stems	2
Barley heads	2
Oat heads	2
Wheat heads	3
Barley straw	4
Oat straw	4
Wheat straw	4
Cow manure	5 (1.2 cms.)
Muck	5 (8.5 cms.)
Peat moss	1
Greenhouse soil	1
Sand	4
Sphagnum moss	5 (1.3 cms.)
Soil No. 5—Sagaponack	1
Soil No. 6—Sagaponack	1
Lima bean agar —check—	6 (8.5 cms.)

Legend: 1—No growth
2—Good growth
3—Excellent growth
4—Sporulation on the original piece of inoculum
5—Diametric growth at the end of 38 days
6—Diametric growth at the end of 12 days

Muck was the only soil on which the organism made any appreciable growth although in some of the others there was a profuse sporulation on the original piece of inoculum. The soil samples from Long Island were obtained from fields on which potatoes had been grown for many years. They contained organic material derived from crops of potato, wheat and rye as these crops are extensively used in the rotation system employed. The fungus, when planted on these soils, failed to sporulate even on the original piece of inoculum. These soils are known to have a relatively high copper content which, in all probability, functioned to prevent the sporulation of the pathogen in this test. A saprophytic phase in the life cycle of *P. infestans* existing in the soil and capable of accounting for the annual outbreak of late blight on Long Island is extremely unlikely.

Overwintering Spores:

On the basis of analogy with other species in the genus *Phytophthora* and with other members of the family Peronosporaceae many workers have been concerned with a search for the sexual reproductive organs *P. infestans*. Smith (1875) reported the presence of oospores in the leaf tissues of infected plants. The negative results of de Bary's search for oospores (1876) have placed Smith's work in disrepute. In 1890, Smorawski reported the presence of oogonia on infected tubers. Jones (1909) and Jones and Lutman (1910) described the formation of resting bodies in cultures of *P. infestans* grown on gelatin or lima bean agar. It remained for Clinton (1911) to produce the sexual reproductive bodies of this fungus in artificial culture. Pethybridge and Murphy (1913) confirmed the results of Clinton. Miss Löhnis (1922) reported that resting spores or immature oospores were formed on the surface of raw potato tubers, while Miss deBruyn (1926) states that oospores were produced on rye, oat and wheat straws, and to a lesser extent on *Equisetum* haulms and, in one case, on bog soil. Resting bodies were found on a variety of substrata—more so on old grass than on potato stems. Desiccated cultures of *P. infestans* survived an exposure to temperatures ranging from 20° to 26° C. for a period of five days. Although no correlation existed between survival of the fungus and the presence of oospores or resting forms, these bodies were suggested as those most likely to resist both cold and drought. Concerned with *P. infestans* on tomato, the report of Berg (1926) that antheridia and oogonia were formed on cultures obtained from Australia, England and Holland but were not formed in his American isolates is highly interesting. Murphy (1927) observed the formation of oogonia and antheridia on the surface of naturally infected as well as on inoculated

tubers. Clinton (1936) was unable to find oospores in nature nor could he find them in humus which previously had been heavily infested.

In the absence of positive data overwintering spores of *P. infestans* cannot be ruled out as a source of primary inoculum. However, the consistent failure of many workers to find oospores in nature, the large number of imperfectly formed sexual organs observed in artificial culture together with the failure to germinate those oospores found would seem to indicate, at the present time at least, that they are relatively unimportant in the overwintering of the fungus. Further, in the area of Long Island, where sporangia will not germinate in the soil and into which the mycelium apparently will not grow, overwintering spores if found in the soil on the same basis would be unimportant as a source of inoculum for primary infections.

Perennial Solanaceous Suscepts:

The suscept range of *P. infestans* is confined to the Solanaceae. Reddick (1928) quoting from numerous sources as well as from his own experiments, lists some of the members of this family susceptible to *P. infestans* of which the following are of interest: *Solanum Dulcamara* L., *S. nigrum* (detached leaves), *S. Melongenum* (susceptible after exposure to humid conditions), *Schizanthus grahami, Antherocercis viscosa, Petunia* hybrids, *Lycopersicum esculentum, Lycium halmifolium* L., *L. turcomanicum* (detached leaves), and *Hyoscyamus niger* (detached leaves). Clinton (1936) could not find any evidence that the fungus overwintered on *Solanum carolinense, S. Dulcamara* or *S. nigrum.*

According to Taylor (1915) in his Flora of the Vicinity of New York, eight genera and twenty species of the Solanaceae are listed as growing wild within an approximate radius of 100 miles from New York. A number of the wild solanaceous plants as well as representatives of this family commonly raised in gardens or as house plants, were grown from seed. When several true leaves were formed, they were inoculated with a culture of *P. infestans.* About five days later the plants were inspected and then subjected to at least ten hours of humid conditions. Notes were taken on the presence or absence of sporulation by the fungus.

Very few of the plants inoculated exhibited a marked susceptibility as is shown in table 3. By far the greater number of plants exhibited varying degrees of resistance. The symptoms ranged from a gradual yellowing and dropping of infected leaves to a few minute black spots. Plants exhibiting symptoms of the latter type, in the absence of sporulation, were classified as immune.

TABLE 3.—*Susceptibility of some solanaceous plants to P. infestans.*

Plants Inoculated	Annual or Perennial	Infection	Fungus Sporulation
Atropa Belladonna L.	Perennial	+	—
Browallia speciosa Hook	Annual		
Capsicum sp.	Annual	+	—
Datura Metel L.	Annual	+	—
D. Stramonium L.	Annual	+	—
Hyoscyamus niger L.	Annual or Biennial	?	
Lycium halmifolium Mill.	Perennial	—	—
Nicandra Physalodes (L) Pers.	Annual	+	—
Nicotiana rustica L.	Annual	?	—
N. Sanderae Sander	Annual	?	—
Nierembergia sp.	Annual	?	—
Petunia axillaris (Lam.) BSP	Annual	+	—
P. violacea Lindl.	Annual		+
P. hybrida Vilm.	Annual	+	
Physalis angulata L.	Annual		+
P. Alkekengi L.	Perennial	—	
P. ixocarpa Brotero	Annual	—	—
P. heterophylla Nees.	Perennial		—
P. peruviana L.	Annual	—	
P. pruinosa L.	Annual		—
P. subglabrata Mackenzie & Bush	Perennial	—	—
P. virginiana Mill.	Perennial		
Salpiglossis sp.	Annual	+	+
Schizanthus sp.	Annual	—	—
Solanum carolinense L.	Perennial	?	—
S. Dulcamara L.	Perennial	+	+
S. nigrum	Annual	+	+
S. Melongena var. *esculentum* Nees.	Perennial	+	—
S. Pseudo-capsicum L.	Perennial	—	—
S. rostratum Dunal.	Annual	+	—

+=Infection or sporulation
—=No infection or no sporulation
?=Minute black specks, no sporulation

Only perennial plants would be important as possible sources of inoculum for primary infections. In this experiment, a number of perennail solanaceous plants were inoculated. Infection appeared to take place on *Atropa Belladonna, Solanum Dulcamara* and *Solanum Melongena* var. *esculentum*. Only on *Solanum Dulcamara,* however, could the fungus be induced to sporulate. Even this plant exhibited a degree of resistance in that infected leaves turned yellow and fell at the slightest disturbance. This plant never has been observed blighting in its natural habitat. The conclusion seems warranted that none of the perennial

members of the Solanaceae found growing wild on Long Island function as overwintering suscepts for *P. infestans.*

Summary

Infected aerial shoots were produced by the growth of mycelium from diseased seed pieces both under controlled and field conditions. Infected plants growing in the cull pile also were incriminated as an important source of primary inoculum.

The germination of sporangia of *P. infestans* was markedly reduced or inhibited in soils obtained from potato fields on Long Island, due probably to the relatively high copper content of these soils. For this reason it is suggested that should overwintering spores be found they also would be unimportant in initiating the disease. No evidence could be obtained for a saprophytic existence of the pathogen in the soil.

Solanum Dulcamara was the only wild perennial solanaceous plant of the eleven species inoculated on which the fungus could be induced to sporulate. It has never been found infected in its natural habitat.

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SECTIONAL NOTES

ALABAMA

Alabama is completing the harvesting of its early commercial potato crop. It has been a hectic season from start to finish. The growers have fought weather, blight, and discouragement. In addition to these trials, they harvested a 60 per cent crop on 17,000 acres. The percentage of No. 1 B size was high, thus forcing the support program to take quite a quantity of B size for dumping. It is needless to say that the dumping program was severely criticized.

The market did not like the Sebago as well as the Triumph. Our growers received $2.25 for U. S. No. 1, whereas the U. S. No. 1 Triumph variety brought $3.00. Despite this, the Sebago will hold its percentage of our total plantings. (June 3).—FRANK GARRETT.

INDIANA

Much of our potato crop is still to be planted since we have had continuous rains in many places, and the muck soils, particularly, are still quite wet. This may mean another week or so before they can get into some of these fields. The season is quite backward in all sections. In the central and southern part of the state potatoes are in the blossom stage at the present time and an examination of a 6-acre field on May 22nd, revealed that late blight had already made its appearance.

Surely something can be done with the surplus of potatoes. A picture of a potato dump covered with kerosene, with a legend underneath it saying that total destruction was desired of a large pile of potatoes, appeared in the Lafayette paper Saturday evening and in the past 48 hours considerable unfavorable comment has developed. I wonder why the producers of these potatoes don't have something to say about what is to be the disposition of their crops. (May 26).—W. B. WARD.

MISSOURI

The prospects for the 1947 commercial potato crop in Missouri looks quite favorable at this time. Despite a late start most of the potatoes are growing well and the first fields of Cobblers are in full bloom. We have had more rain than was needed and the temperature on the average has been cooler than normal.

Weather conditions are favorable for blight but as yet no blight has been reported. Most fields have had at least two applications of copper-DDT dust, and one or two additional applications will be given before harvest time. A 6 per cent copper and 3 per cent DDT dust is in

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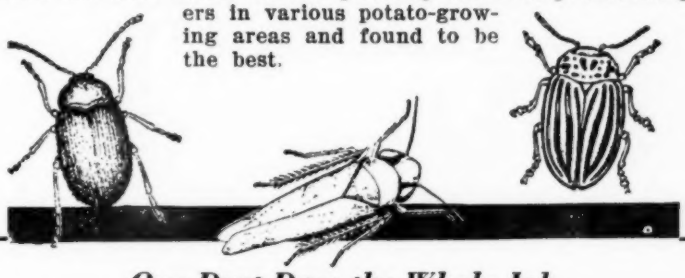

One Dust Does the Whole Job

KILLS INSECTS: Mack-O-Blend with DDT kills Colorado Potato Beetles, Potato Flea Beetles, Potato Leafhoppers, Tarnished Plant Bugs, Potato Psyllid and Blister Beetles, the important potato insects.

BLIGHT PROTECTION: Mack-O-Blend with DDT contains the most effective form of copper in the proper amount for blight protection — the time-proven blight control. It is a low solubility salt that will not injure vines but tends to stimulate plant growth and increase yields.

"Super-Fused" for Uniform Control

By special blending machinery, McConnon insecticides and fungicides are "Super-Fused." The toxics are accurately and thoroughly mixed with the diluents to assure uniformity and avoid spotty control.

McConnon also makes fungicide dusts containing the proper amount of metallic copper, and a complete line of insecticides and fungicides.

BE PREPARED. Don't wait until trouble strikes. WRITE us at once for literature and recommendations.

McCONNON & COMPANY Insecticide Division Winona, Minnesota

common use. Tractor-type dusters are used in most fields, with airplane dusting being used only on a very limited scale. Airplane dusting may be used more later in the season because of the increasing difficulty of getting tractor wheels through the row middles without damage to the plants.

The current outlook would indicate that digging will probably begin the first week in July. (June 7).—ALLEN PURDY.

NEW JERSEY

Because of the excellent weather conditions, our potatoes are making rapid growth throughout the state. Most plantings show fair to good stands, although there are numerous fields with poor stands. Some of these poor stands were caused by fusarium rot in the seed pieces and some to excessive rainfall, which has drained out the potatoes in many low poorly-drained areas.

Potato plants that were frozen to the ground on the 9th and 10th of May have made good recovery in most instances and relatively little damage was caused. Many fields of Cobblers are now in bloom,—especially in South Jersey. Harvesting will not start until approximately the 10th or 15th of July because of the late planting this season.

Some growers have expressed disappointment in some of the provisions required by P. M. A. in order that they become eligible for price support. Among these provisions is one that requires the grower to pay the government 1 cent per cwt. on their estimated production, when their application is filed. (July 11 is latest date). It is felt that growers should be allowed to make the payment at the end of the season rather than before they start harvesting, first because some will have to borrow the money; and secondly, because the estimates may be very misleading. It is also pointed out that no rebate will be made if the grower overestimates his production and no tolerance will be allowed for overplanting his allotment.

The entire executive committee of the Potato Association of America met at Rutgers University from the 2d to the 4th of June, and drew up a new constitution. They also made other important plans for future activities of the association. The members of this association may rest assured that the future of their association is in competent hands. (June 18).—J. C. CAMPBELL.

NEW YORK

Ordinarily potato growers begin planting in up-state New York about the last week in April, some before that. But on the 31st of May we found very few potatoes planted except in the very earliest and

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Through complete insect control and blight protection by the use of

C-O-C-S NIATOX DUSTS

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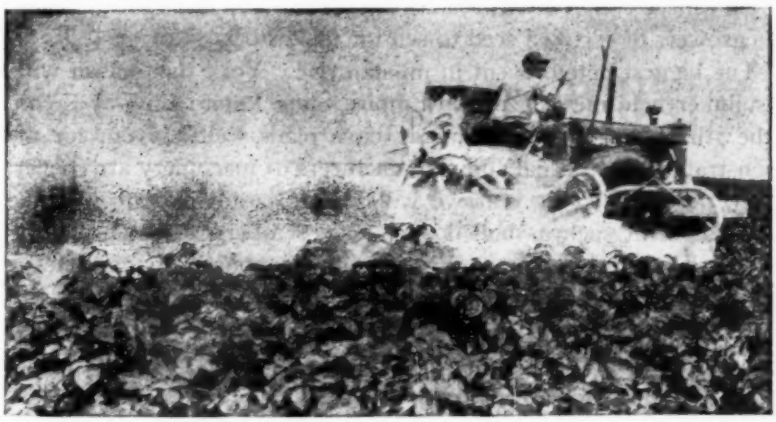
plus

NIATOX CROP SPRAY

a micro-milled 50% DDT wettable powder



For economical, time-saving applications, these sturdy and dependable Niagara crop dusters are available: 24 nozzle Cyclone dusters, Dri-Fog dusters, Cropmaster dusters and Model AA Tractor Take-off Dusters. For wireworm control, ask your dealer for Niagara BHC (Benzene Hexachloride) materials. *"When you buy Niagara, you buy protection."*

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driest areas. During the month of May, according to the United States Weather bureau, there were five days when it did not rain.

Because of the lateness of the season many growers have sold some of their seed. On the other hand this will not affect the acreage much because other growers have increased their acreage since it is too late to plant some earlier crops such as grain which some of our growers use in their rotation.

The fertilizer allotment was about 10 per cent under last year's planting but present indications are that the actual acreages planted will be about 20 per cent under last year. With a light acreage and planting a month later than usual we expect very light yields compared with normal and consequently a lot less than last year. Some of our serious minded potato men will not worry about a potato shortage and think there will be a surplus for next fall and winter.

The demand for certified seed has been good all spring and the supply was cleaned up rather early. Actually there was a shortage of certified seed in some areas because of the sudden rise in the table stock market which, coupled with bad weather and the late season, induced some growers of certified seed to sell for table stock.

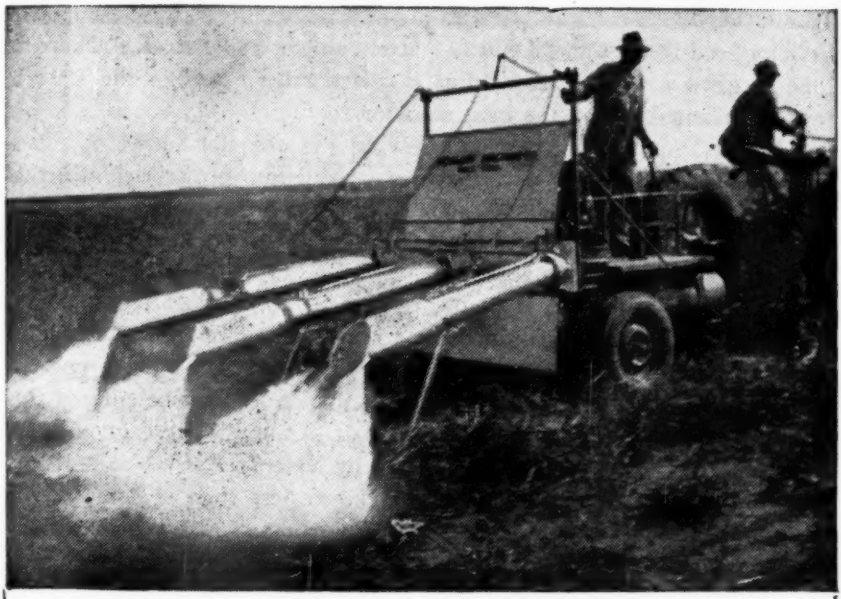
The biggest potato event in up-state New York this season will be the summer field meeting of the Empire State Potato Club at Richford on the 7th of August. We already have plans well laid out for more demonstrations than usual and manufacturers of machinery are cooperating 100 per cent. This year we will feature besides potato machinery other equipment such as bull dozers, road scrapers, etc., which can be used to kill hedges; construct diversion ditches, burying stone piles and other improvement projects.

The College of Agriculture has five acres for plots showing new varieties, the results of various fertilizer applications, insecticides, fungicides, etc. (May 31).—H. J. Evans.

OHIO

Both April and May have been very wet in Ohio. The rainfall was below normal the first three months of the year, and although the total rainfall to date is not so much above normal, still the rainfall in both April and May was far above normal so that we had a total of more than 10 inches of rain during these two months. The rains during these two months were not so heavy, but it rained so many days that it kept the growers from planting potatoes.

The Cobblers are planted in the southern half of the state, but there are practically no potatoes planted in northern Ohio. Some of the



MODEL PB-3 WEED BURNER

The Model PB-3 is here shown in use in potato fields. Used to destroy green immature vines it permits harvesting operations without waiting for normal maturing of vines or their elimination by killing frost.

Vegetation which has accumulated after cultivating is no longer possible, is completely eradicated and permits efficient digger operation. Clean fields result in fewer potatoes being lost as they can easily be seen by pickers.

The use of the Model PB-3 is not restricted to the burning of potato vines as it can be used wherever weed eradication is necessary.

At a speed of 5 m.p.h. the Model PB-3 consumes 18 gallons of fuel oil per acre and burns 4 rows or a swath 15 feet wide on each trip.

References by potato growers using the Model PB-3 furnished on request. They will give you their actual experience with the use of this machine.

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Pioneer Manufacturers of Open Flame Type Weed Burners

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Cobbler seed in northern Ohio has been sold for table stock. There is time to grow a crop of Katahdins in the northern part of the state if they are planted within the next week or so.

If we have dry hot weather during the summer our crop, as a whole, will be late, and we can expect a reduction in our yields in this state. (June 4).—E. B. TUSSING.

OREGON

In common with most of the rest of the country, Oregon potato acreage was substantially reduced this year. It is likely that acreage of certified seed will also be reduced. We had over 5,000 acres entered in 1946 and indications are that not more than 4,000 will be entered this year. Last year we rejected about one-half of the total acreage entered. Rejections last year were mostly caused by leafroll.

Government purchases in this state were less than in some of the other states because of the fact that during most of the year the f.o.b. price for good table stock was at or above the support price. We had one serious situation, however, that resulted in purchases of a great many carloads. Leafroll was exceptionally serious and the current season form resulted in net necrosis or internal browning of some of the tubers. Of course, it was impossible to sort these out and whenever a grower discovered that he had internal browning in enough of his crop to cause it to be rejected when sold to a commercial buyer, he immediately turned that to the Government.

This, of course, made a very handy thing for him, but as soon as government support prices are out, that method of disposing of potatoes affected by leafroll will no longer be possible. In fact, government agencies have already announced that they will not accept such lots if offered to them in 1947.

Had it not been for this internal browning situation, there would have been very few potatoes turned to the government in this state last year. It is not anticipated now that there will be any need for government purchases this coming year in Oregon. (June 11).—E. R. JACKMAN.

PENNSYLVANIA

Planting is late and still is not finished, but should be completed about the 20th of June. The inclement spring weather has resulted in a cut in acreage, which, when added, to the reduction resulting from the high cost of labor amounts to 10 per cent. The trends in potato production are toward specialization. The small grower is dropping out of production or increasing his acreage to 100 acres, or even more. Another

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"FERTILIZER STUDIES WITH POTATOES"

by Ora Smith and W. C. Kelly, Department of Vegetable Crops, Cornell University. Reprinted from April, 1946, issue of American Potato Journal.

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trend is toward white skinned-varieties of the season of Katahdin. Rural Russets are losing in favor and Cobblers are being grown in only a few counties.

Most farmers are using more fertilizer than in the past,—1,500 pounds or more per acre applied in bands along the row. Some growers are plowing down an additional 500 pounds. This increase in amount of fertilizer applied is based on farmer's experience rather than experimental results. (June 3).—O. D. BURKE.

SOUTH DAKOTA

Potato planting in South Dakota is still under way in the area at this writing, the 5th of June. The season was very late and growers, who also raise small grain did not get started planting potatoes until around the first of June. The acreage will be about the same as last year or possibly 5 to 10 per cent less. Much new foundation seed has been shipped into the area from Wisconsin, Minnesota and North Dakota.

Potatoes that were planted by the larger growers in May are beginning to come up but it does not look as if there will be any field inspection work before the 23rd or 24th of June. David Giese, formerly of Moorehead, will again be the head field inspector for the South Dakota Potato Growers' Association.

A hearing on a proposed marketing agreement will be held in Watertown on the 19th and 20th of June by the Solicitor's Office from Washington. The present plans are to include all of South Dakota East of the Missouri River in the agreement, but this area may be changed as a result of the hearing. Mr. R. E. Keller, of the Fruit and Vegetable Branch from Chicago, has explained the marketing agreement to growers.

The State Potato Advisory Committee met in Watertown the 29th of May and recommended marketing survey allowances for the 1947 crop.

It is doubtful if the annual tour of the potato growers will be resumed this season. This was always a leading event in potato circles and was usually held about the 18th or 20th of July. (June 5).—JOHN NOONAN.

CANADA

During the month of May a seed company in London, Ontario, fumigated their warehouse for rodents, using larvacide (Chloropicrin) at the rate of 50 pounds to 197,500 cubic feet.

There were approximately 200 bags of certified seed potatoes stored

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- COLORADO POTATO BEETLES
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Field tests made during the 1946 season showed Syndeet-30 to be the outstanding emulsion type DDT spray for insect control. It proved more *effective*—more *economical*.

Recommended Dosages

For Flea Beetles, Leaf Hoppers and Colorado Potato Beetles—use 1 pint of Syndeet-30 per 100 gallons of water. Apply at the rate of 100-150 gallons per acre.

For Aphids and other potato insects—use 1 pint of Syndeet-30 per 100 gallons per acre if infestation is light. Use 1 quart per 100 gallons if infestation is heavy, and apply at 130-150 gallons per acre.

Syndeet-30 contains 30% DDT in a synthetic insecticidal oil for aphid control.

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in the warehouse at the time of the fumigation. In due course these potatoes were sold to growers. When the growers started cutting the seed they discovered that the tubers showed depressed areas, varying in size from ⅛ of an inch to patches covering most of the tuber. In addition, the eyes were mostly dead. The growers returned the seed to the company, who called in the local inspector of the Plant Protection Division of the Dominion Department of Agriculture. At first no explanation was given, but the local inspector was asked to investigate the matter throughout, and it was then discovered that these potatoes were in the warehouse at the time of the fumigation. As practically all the eyes were killed, the certification tags were removed from the bags and the Department of National Health and Welfare asked to ascertain if these potatoes were fit for food.

This Department reported that the potatoes could be decontaminated by airing for 24 to 48 hours. No residue was found in cooked potatoes, and the flavor was unimpaired.

Incidentally, the rodents were all killed. (June 7).—J. W. SCANNELL.

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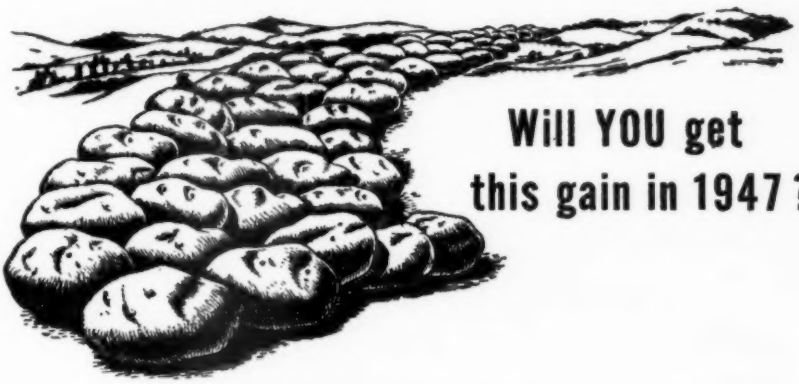

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Last year, DDT definitely proved itself as an effective agent for controlling infestations of the Colorado Potato Beetle, Potato Flea Beetle and Potato Aphid. Tests conducted at Federal and State Experiment Stations, as well as actual crop figures, indicated an average potato yield increase of *25 barrels per acre* through control of these insect pests.

A Penco DDT program this year will help you show substantial increases, too. Penco DDT compounds are made by Pennsalt —a leading basic producer of DDT—are high-quality, dependable, *proven* in actual use. Let your Penco Distributor assist in selecting the right formulation, and the proper application of DDT for real results. See him today.

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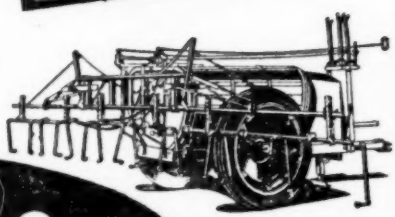

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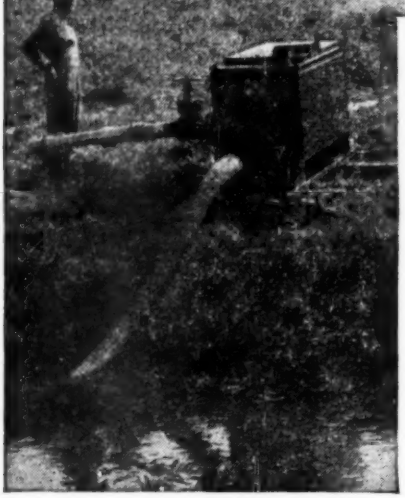

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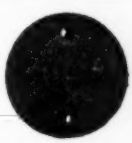

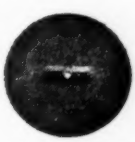

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HUNGER SIGNS IN CROPS

Growing plants should be observed closely for signs which may denote plant-food starvation. Potatoes, for instance, will show their need for potash with leaves that have an unnatural, dark green color and become crinkled and somewhat thickened. Later on, the tip will become yellowed and scorched. This tipburn then will extend along the leaf margins and inward toward the midrib, usually curling the leaf downward and resulting in premature dying.

Valuable as this method of diagnosis has proven, it has its limitations owing to inter-relationships of nutrients in the plant and to other factors that might cause abnormalities. Recently it has been observed that when an application of a nutrient has not produced the expected results, a hardpan of impermeable layer in the soil may offer an explanation. Restricted root zone, reduction of capillary action, and limited quantities of oxygen lessen a plant's ability to absorb nutrients that might be in the soil and available if the hardpan were eliminated.

In determining fertility requirements, therefore, it may be well to consider not only the surface soil but also what is underneath. The greater the volume of soil in which plants can breathe, eat, and drink, the greater the insurance of a good crop.

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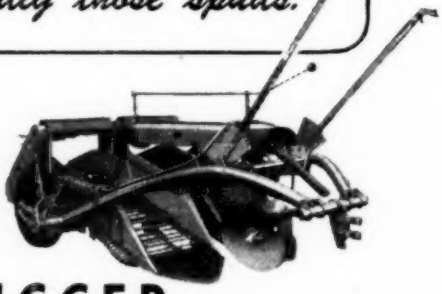

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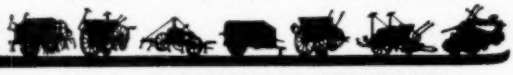

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